The invention concerns a method for operating a strip casting machine for producing a metal strip according to the main description of Claim 1 and a device for carrying out said method.

During casting between two casting rolls forming a casting gap sealing plates are held against the facing surfaces of the casting rolls to contain and hold the molten metal between the rolls. Mostly the fire-proof sealing plates are pressed against the rotating casting rolls. During this the sealing surfaces are subjected to substantial wear. In the area of the sealing edges an undesired partial solidification can occur, which in turn may result in damage to the sealing plates along the roll edges. The wash-out, i.e. the wear from the sealing plates within the edge area of the casting rolls will result in poorly cast edges in the metal strip and in the formation of fins in this area. The metal strip with possible fins produced in this way can cause further wear on the sealing plates on the one hand, and can give rise to edge cracks in the metal strip on the other, which will necessitate substantial edge trimming and therefore reject losses, which will have a negative effect on the efficiency of the method.

Strip casting machines are known where the side seals can be moved or rotated in an oscillating manner in a horizontal or vertical direction in order to avoid uneven wear of the sealing plates, and also to prevent an adhering of the metal strip produced. However, even with these solutions the risk of a possible partial solidification occurring in the area of the roll edges between the sealing plate and the facing side of the rolls still exists, and partial wear on the one hand as well as strip edge faults on the other may result.

It is therefore the task of this invention to provide a method of the type mentioned above as well as a device for carrying out said method, with which the strip edge quality can be substantially improved and the efficiency of the method increased.

This task is solved in accordance with the invention my a method with the characteristics of Claim 1 as well as a device with the characteristics of Claim 9.

Preferred embodiments of the method of the invention and the device of the invention form the subject of the dependent subclaims.

The fact that according to the invention the sealing plates are moved inwardly and against the direction of periphery of the casting rolls in an oscillating manner during the casting operation, whereby the movement occurs alternately along one or the other casting roll edge, means that the occurrence of a partial solidification can be mostly prevented and possibly removed, and that the metal strip produced in this way will comprise clean strip edges. Strip edge cracks as well as strong signs of wear on the sealing plates will be prevented, which will in turn increase the efficiency of the method (reject losses due to substantial edge cutting is avoided, and longer casting sequences are possible).

The invention will now be described in more detail with reference to the drawings, whereby:

Fig. 1 shows a perspective illustration of a first embodiment of a device for producing oscillating movements at the side seals of the roll strip casting machine;

Fig. 2 shows a cross-sectional view of a part of the roll strip casting machine with the device according to Fig. 1;

Fig. 3 shows a side view of a part of the roll strip casting machine with the device of Fig. 1;

Fig. 4 shows a schematic view of a side seal;

Fig. 5 shows a schematic view of the side seal of Fig. 4 during the oscillating movement along a first casting roll edge;
Fig. 6 shows a schematic view of the side seal of Fig. 4 during the oscillating movement along a second casting roll edge;
Fig. 7 shows a perspective and a cross-sectional view of a lower part of the device of Fig. 1;
Fig. 8 shows an overview of the part of Fig. 7;
Fig. 9 shows a perspective and a cross-sectional view of an upper part of Fig. 1;
Fig. 10 shows an overview of the part of Fig. 9; and
Fig. 11 shows a perspective illustration of a second embodiment of a device for producing oscillating movements at the side seals of a roll casting strip machine.
Figs. 1 to 3 show a device 1 for producing oscillating movements at the side seals 2 of a roll strip casting machine which is envisaged for producing a metal strip by continuously pouring molten metal between two casting rolls forming a casting gap. The casting rolls can be seen in Fig. 2 and have been allocated the reference numbers 3, 4. Two side seals 2 located at both facing sides of the casting rolls 3,4 limit the longitudinal expansion of the casting gap and therefore determine the width of the metal strip to be produced. One device 1 each is envisaged for the relevant side seals 2.
The side seals 2 each comprise one fire-proof sealing plate located in a holding frame 2a (see Fig. 3), which can be adjusted against the facing surfaces 3a, 4a of the casting rolls 3, 4 by means of an adjustment device 5 that in itself is known and does not need to be described in detail here. The adjustment device 5 is located on a frame 6. The adjustment device 5 is allocated to a base plate 10 of the device 1. On the base plate 10 on the one hand, and on the holding frame 2a of the side seal 2 on the other a fork-shaped holder 11, 12 each is affixed, the vertically extending shanks of which are connected with each other with a horizontally aligned transverse bolt 13, 14. On the two transverse bolts 13, 14 a substantially vertically orientated piston/cylinder unit is located, the same being slightly tiltable in relation to a vertical plane extending parallel to the base plate 10 and to the side seal 2, for which the inside surfaces of the shanks can for example take on a slightly convex form at both holders 11, 12. The piston/cylinder unit is connected with a drive in a way not shown in detail here and has the purpose of creating an oscillating movement of the side seals 2 with its up/down movement, which is however not vertical according to the invention, but extends against the direction of periphery U_3, i.e. U_4 (Fig. 2) of the casting rolls 3, 4, namely alternately along one or the other casting roll edge 3k, i.e. 4k as shown in Figs. 5 and 6. In this way each point of the so-called sealing area 7 of the sealing plate 2b is set - as illustrated in Figs. 4 and 5 – from a neutral position c into an oscillating movement at the circumference of a circle with a centre D_3 (axis of rotation of the casting roll 3) and with the roll radius a in the direction of periphery U_3, i.e. in the casting direction, up to the lower dead point d and back against the direction of periphery U_3 up to an upper dead point b. Fig. 6 shows that each point of the sealing area 7 can also oscillate from a neutral position f on the circumference of a circle with a centre D_4 (axis of rotation of the casting roll 4) and with the roll radius a in the direction of periphery U_4 between a lower dead point g and an upper dead point e.
To convert the oscillating up/down movement created by the piston/cylinder unit into the oscillating movement of the side seals 2 according to the invention as described

above the side seals 2 on the one hand and the locationally fixed base plate 10 on the other are allocated guide elements, the first part of which is envisaged for steering the side seals 2 along one casting roll edge 3k, and the second part of which for steering the side seals 2 along the other casting roll edge 4k. In addition adjustment means are provided with which the first or the second part of the guide elements can be used alternately. These guide elements as well as the adjustment means will now be described in more detail with reference to Figs. 1 to 3 as well as Figs. 7 to 10.
On the base plate 10 three position cylinders 20, 23, 24 (see Figs. 1 and 3) are located, preferably screwed into the same, of which one, the position cylinder 20, is located in the lower area of the device 1 in such a way that its axis extends in the area of the casting gap, i.e. substantially along a plane that is common to both of the casting roll axis D_3, D_4. The two other position cylinders 23, 24 are positioned symmetrical in relation to the vertical central axis of the base plate 10, i.e. the side seals 2 in the upper area of the device 1, i.e. they are allocated within the expanded area of the side seal 2 and are located at both sides of the fork-shaped holder 11 for the piston/cylinder unit.
The lower position cylinder 20 is equipped with a holder 25 for two guide cylinders 33, 34 arranged horizontally at a right angle to the position cylinder 20 and facing each other, the adjustable pistons 33a, 34a of which each serve as support for a guide roll 35, 36. As is also visible from Figs. 9 and 10 the guide rolls 35, 36 are bearingly and rotatably positioned on bolts 35a, 36a which are aligned at right angles to the pistons 33a, 34a and connected with the same. With the pistons 33a, 34a the guide rolls 35, 36 can be pressed against a lower circular guide 40 fitted, and preferably screwed, to the side seals 2, i.e. the holding frame 2a of the same on both sides. The cross-section of the circular guide 40 comprises rounded outside, i.e. guide surfaces 41, 42 which co-operate with similarly formed circumferential surfaces 35u, 36u of the guide rolls 35, 36. The lower position cylinder 20 as well as the lower circular guide 40 are located below the lower holder 12 for the piston/cylinder unit 15.
The upper position cylinders 23, 24 also each comprise a guide cylinder 43, 44 (see especially Fig. 2), the pistons 43a, 44a of which each serve as a support for a guide roll 45, 46. The guide rolls 45, 46 in turn are bearingly and rotatably positioned on bolts 45a, 46a positioned at right angles to the pistons 43a, 44a (see Figs. 7 and 8). On the side seal 2, i.e. the holding frame 2a two upper circular guides 51, 52 of the same are affixed, i.e. screwed on in the upper area, which are each equipped with a side guide surface 53, 54 facing the outside edge of the side seal 2. The rounded guide surfaces 53, 54 with their outwardly dome-shaped cross-section each co-operate with correspondingly shaped circumferential surfaces 45u, 46u of the guide rolls 45, 46.
The upper circular guides 51, 52 are arranged in such a way that their guide surfaces 53, 54 each lie along the circumference of the circle with the radius a and the centre D_3 (circular guide 51), i.e. D_4 (circular guide 52) already mentioned above. Around the circumference of the relevant circle the relevant outside surface 41, i.e. 42 of the lower circular guide 40 is also located. The upper guide cylinders 43, 44 are aligned in such a way that the guide rolls 45, 46 are adjusted at a right angle to the relevant guide surfaces 53, 54 during the adjustment of its pistons 43a, 44a to bring them into tangential contact with the same. As already mentioned the pistons 33a, 43a and pistons 34a, 44a are activated alternately according to this invention, and the guide rolls 35, 45 are therefore alternately pressed against the guide surfaces 41, 53, then the

guide rolls 36, 46 against the guide surfaces 42, 54, so that the oscillating up/down movement of the piston/cylinder unit 15 alternately oscillates the side seals 2 as shown in Fig. 5, and then as shown in Fig. 6.

Instead of a single lower circular guide 40 with two outside surfaces 41, 42 it is of course also possible to use two separate circular guides with one outside surface each affixed to the holding frame 2a.

Instead of the piston/cylinder unit 15 it is also possible to use a different conventional drive unit for generating the up and down movements.

The oscillating frequency can be varied, whereby the movement of the side seals 2, i.e. the fire-proof sealing plates 2b integrated into the same, in the direction of periphery U_3, i.e. U_4 of the casting rolls 3, 4, i.e. the casting direction, can be a little faster, the same, or even substantially slower than the movement of the rotating surface of the casting rolls 3, 4. With other words: a minimal prior advance, an equal advance, or possibly even a substantially lower advance is possible.

The movement of the sealing plate 2b against the direction of periphery U_3, i.e. U_4 of the casting rolls 3, 4, i.e. the return movement, can be faster, the same, or even substantially slower than the casting direction movement mentioned above.

The oscillating frequency can vary depending on the casting speed. For a simple control the oscillating frequency can however also be fixed to suit a conventional casting speed.

The lift of the sealing plates 2b can preferably be +/- 0,5 to +/- 10mm and occur at a speed that is up to 10% faster during the casting direction movement, and up to 10 times slower during the return movement.

The fact that according to the invention the side seals 2, i.e. the fire-proof sealing plates 2b integrated into the same are moved in an oscillating way in and against the direction of periphery U_3, i.e. U_4 of the casting rolls 3, 4 during the casting operation, whereby the movement can occur alternately along one or the other casting roll edge 3k, 4k means that the creation of partial solidifications can be mostly prevented and removed if need be, and that the resulting metal strip can be produced with clean strip edges. Strip edge cracks as well as strong signs of wear on the sealing plates 2b can be avoided, so that the efficiency of the method is increased (reject losses due to substantial edge cutting are prevented, and longer casting sequences are possible).

Fig. 11 shows a further embodiment of a device 1' for generating oscillating movements on side seals of a roll strip casting machine. It once again comprises a fixed base plate 100, opposite which a further plate 102 connected with the side seal is moveably located. The side seal itself is not illustrated in Fig. 11, but the plate 102 is affixed in the holding frame of the side seal that receives a sealing plate already mentioned above.

The moveable plate 102 comprises two side guide surfaces 103, 104 along its outside circumference, which each lie on the circumference of a circle with the casting roll radius a and a centre D_3, i.e. D_4 (see Fig. 4 and Fig. 5) corresponding to the axis of rotation of the relevant casting roll 3, i.e. 4. The guide surfaces 103, 104 are co-operatively connected with two guide roll pairs 105, 106, 107, 108 symmetrically located in relation to the vertical central plane of the base plate on the fixed base plate 100, of which one guide roll pair 105, 106 is located in a lower, and the other guide roll pair 107, 108 in an upper, extended area.

In the upper area of the moveable plate 102 a recess 110 that is symmetrical in relation to the vertical central plane of the same is located, into which two eccenters 111, 112 project through the base plate 100 from behind. The eccenters 111, 112 can be driven by a drive not shown in the drawing and located outside of the hot section via a drive shaft 113 and a gear wheel 144, 115; 116, 117 in a counter direction. The gear wheel 114 is located on the drive shaft 113, the gear wheel 115 engaged with the same sits on a shaft allocated to one eccenter 111 and is bearingly positioned in a holder 120, on which a further gear wheel 116 is also positioned, which engages a gear wheel 117 driven by the other eccenter 112.

The two eccenters 111, 112 and the inside surfaces of the recess 110 are matched to each other by means of friction closure in such a way that the moveable plate 102 remains in constant contact with the lower guide rolls 105, 106 with its guide surfaces 103, 104 during a rotation of the eccenters 111, 112, although the same is pressed alternately against one or the other upper guide roll 107, 108. In this way the plate 102, and with it the side seal, carries out a kind of oscillating V movement alternately along one or the other casting roll edge 3k, i.e. 4k. The lift of the sealing plates can preferably be from between 0 and 1mm to between 0 and 20mm.

The side seal with the moveable plate 102 as well as the base plate 100 with the holder 120 and the gear wheels 115, 116, 117 bearingly positioned in the same form a unit which is inserted from below following pre-heating in order to fixedly drive the gear wheel 114 located on the drive shaft 113, whereby the gear wheel 115 is brought into engagement with the fixed gear wheel 114.

In principle the two upper guide rolls 107, 108 of Fig. 11 can be omitted, and the guiding of the moveable plate 102 can be carried out by the two eccenters 111, 112 engaging the recess 110. The plate 102 would then be held and guided by these eccenters 111, 112 on the one hand, and by the two guide rolls 105, 106 located at the lower end on the other.

In addition a spring, preferably a pressure spring, can be located between the plate 102 and the base plate 100, which effects that the moveable plate 102 is always pressed against the eccenters in a downward direction with the inside surfaces of its recess 110, so that a gap-free positive abutment by means of friction closure of the eccenters is guaranteed.